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# DIGITAL COMPUTER NEWSLETTER

**OFFICE OF NAVAL RESEARCH · MATHEMATICAL SCIENCES DIVISION**

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## **COMPUTERS, U.S.A.**

### **AIR FORCE ARMAMENT CENTER - ARDC - EGLIN AIR FORCE BASE, FLORIDA**

The on-line Univac High Speed Printer has been installed at and accepted by the Air Force Armament Center, and has demonstrated remarkable ability in reducing output time on the Univac Scientific 1103 computing system. On one of our "bread and butter" problems, the computer time per point of data has been reduced from 8-10 seconds to 2 seconds, and hard copy is immediately available rather than punched paper tape which required several Flexowriter hours before the printed results were obtained. Also, a dump of the entire E.S. now requires thirty seconds.

The Air Force Armament Center will be the proving ground for a Digital Flight Test Instrumentation System developed at M.L.T. This system will write digital information on a Davies airborne magnetic tape recorder. This tape will be played directly into the 1103 computer, and the results may be displayed on a Charactron cathode ray tube under the control of a system of manual intervention switches. The entire system, a joint effort of M.L.T., Emerson Electric, and the AFAC, is scheduled to be operational by late summer, and, on a limited basis, to be gathering data in the very near future.

The AFAC is also embarking on a system of transmitting data and results between Edwards AFB, Kirtland AFB and Air Force Armament Center. The initial philosophy is to rough-process data on the Readix, a computer at the Pasadena office of the Ballistics Test Facility. These results will be transmitted via the Teledata system to both Kirtland AFB and the AFAC. At AFAC the additional computations will be accomplished to prepare interim or final bomb ballistics tables.

### **AIR FORCE CAMBRIDGE RESEARCH CENTER - BEDFORD, MASS.**

The Cambridge Computer, built by Remington Rand Univac Division of Sperry-Rand, was installed at the Air Force Cambridge Research Center last May and is now in operation. It is a serial-decimal machine with drum storage. Drum capacity is 2000 words of ten digits each plus a sign digit. The words are packed two hundred per track. Sixteen hundred of these words are located in tracks containing a single reading head, and each of the tracks corresponding to the remaining four hundred words have four reading heads.

Circuitry almost exclusively utilizes magnetic amplifiers and diode logic of a digital rate of 660KC. The entire computer is contained in two units; the central computer is 7-1/2' x 2' x 6' high and the control console is 3' x 6' x 4-1/2' high.

Input is either from a keyboard, or from paper tape through a Ferranti Photoelectric Tape Reader. The output is either printed on a Flexowriter or punched on paper tape. While the machine is a general purpose computer, it was designed with an eye toward special purpose use in an air defense system, and there are additional input-output devices associated with this use.

Typical operation is characterized by the following times:

| Access Time | Fast Bands | Slow Bands          |
|-------------|------------|---------------------|
| Minimum     | 36.6       | 36.6 (microseconds) |
| Maximum     | 933.3      | " 3678.3 "          |

The minimum add time is 91.5 micro-seconds including the access time. Latency coding is possible as the computer utilizes a two address code.

## RECOMP - AUTONETICS - DOWNEY, CALIFORNIA

RECOMP, a transportable, midget computer, has been designed and developed by AUTONETICS, a division of North American Aviation, Inc. The first model of this general-purpose, all-transistor digital computer, designated CP-286, has been produced and delivered to the U.S. Air Force Rome Air Development Center.

From a study of the Air Force's specific needs in the field, a general-purpose computer was indicated whose performance capabilities would be as nearly equal as possible to those of computers costing as much as \$250,000 installed. As a result, the RECOMP, which is a serial, single-address, internally binary computer, has from 12 to 16 arithmetic instructions, 17 logical and transfer instructions, and from 5 to 8 input/output instructions. It was designed to utilize a rotary magnetic disc memory with a main memory capacity of 2048 words and 4 arithmetic registers (a new model has a 4032 word capacity). Each word consists of 40 bits, including sign and 2 instructions. Average access time to the non-volatile main memory is 17.4 milliseconds, and to the 18-word high speed loops, 1.82 milliseconds. Normal mode of operation utilizes either fixed or fixed and floating-point instructions. Information can be fed into the computer by decimal entry of mixed numbers, using the electric typewriter, paper tape reader, or control panel keyboard; output of the computer may be decimal, octal, or binary. When decimal or octal it can be printed, recorded on paper tape, or displayed on the control panel. Alpha-numeric output is obtainable under program control. For added convenience, the visual readout displays memory or arithmetic information in arabic form up to 15 digits, with sign and decimal point. Numbers, commands, or locations can be entered, read, or changed as required.

To meet the requirements for portability (and compactness), transistors and small, etched-circuit cards are used exclusively. As a result, it is one-sixth the size of an office desk and weighs about 200 lbs. It can be carried suitcase fashion by two men, transported (without bracing or padding) in a jeep or weapons carrier, or even carried in the baggage compartment of an airplane or train along with the programmer's personal luggage. To make the computer convenient to use, the need for set-up time and special electrical power and connections have been avoided, and the computer can be plugged into any standard source of 115 volt 50-60 cps a-c. Power dissipation does not exceed 600 watts.

Circuitry is standardized in the form of 4 basic types of small, plug-in, etched-circuit cards mounted on hinged panels for quick access. By limiting the basic types of etched-card types to 4, problems of downtime and large numbers of spare parts were virtually eliminated. To further simplify maintenance work, automatic self-checking provisions are incorporated to verify the original input tape at any time, check out new programs, catch malfunctions in the tape reader, and detect any malfunctions of the typewriter or tape punch units during computer output. To provide backup support for periodic checks and maintenance, a mobile test set is provided. This test set makes marginal checks, gives a visual readout of each flip-flop, monitors computer operation by slow or one-shot pulsing, and tests and assists in alignment of the plug-in cards. In addition, the test set is designed to reduce the safety factors of the computer to facilitate testing.

The RECOMP is equally applicable for industry problems in exploration, surveying, construction, and navigation.

## CORPS OF ENGINEERS - U. S. ARMY

The Corps of Engineers has been using computers since 1952. Computers currently in operation include the following:

| <u>Agency &amp; Location</u>                   | <u>Computer</u>                            | <u>Applications</u>   |
|--|--|---|
| Army Map Service,<br>Washington, D. C.         | Univac I,<br>RemRand 409.2R,<br>Monrobot V | Geodetic computations, Class IV<br>requirements forecasting, survey<br>data, & cost accounting. |
| Supply Control Office,<br>Fort Monmouth, N. J. | IBM 650 (card input)                       | Inventory control, cataloging, supply<br>control (General Engineer Items).                      |

| <u>Agency &amp; Location</u>             | <u>Computer</u>      | <u>Applications</u>                           |
|--|----------------------|---|
| Ohio River Division,<br>Cincinnati, Ohio | Durroughs E-101      | Hydrologic computations.                      |
| North Pacific Div.,<br>Portland, Oregon  | IBM 080 (card input) | Power generation and hydrologic computations. |

The following computer installations are under development:

| <u>Agency &amp; Location</u>  | <u>Computer</u>       | <u>Applications</u>  | <u>Target Date</u> |
|---|-----------------------|--|--------------------|
| Engineer Maintenance<br>Center,<br>Columbus, Ohio                           | IBM 705               | Inventory control<br>document processing &<br>requirements forecasting<br>(Engineer Spare Parts).            | June 1957          |
| Engineer Mathematical<br>Computation Division                               | Univac Scientific     | Bomb damage assessment<br>& related mathematical<br>computations.  | March 1957         |
| Engineer Research and<br>Development Laboratories,<br>Ft. Belvoir, Virginia | IBM 650 (card input)  | Engineering & business<br>computations in support<br>of Engineer Research &<br>Development Program.          | Summer 1957        |
| Engineer Supply Control<br>Office,<br>St. Louis, Missouri                   | IBM 650 (tape system) | Inventory control, cata-<br>logging, supply control,<br>financial management<br>(General Engineer<br>Items). | June 1957          |

Computer activities within the Corps of Engineers are centrally coordinated by the Electronic Data Processing Systems Coordination Branch in Requirements Division, Military Supply, Office Chief of Engineers. Future planning for expansion includes orientation and training by agencies not now possessing computers, procurement of computers as justified, liaison with computer manufacturers and communication equipment companies and cooperation with other governmental and non-governmental computer users. Long range planning envisions the possible development of automatic integrated data processing and computation systems in support of the current Corps of Engineers assigned missions.

#### IBM - NEW YORK, NEW YORK

Type 709 Electronic Data Processing System. International Business Machines Corporation has announced the Type 709 Electronic Data Processing System. The features listed below give it a versatility which will enable it to be applied to both scientific and business problems. A typical system would lease for around \$56,000 a month or sell for about \$3,000,000.

1. The 729 Magnetic Tape Unit (Model 1). For the first time, writing on magnetic tape is checked at the time of writing. This is accomplished by a two-gap head which not only writes in the first position, but also reads in the second position. Information read is subject to an immediate validity check. Assurance is thus provided without reruns, that readable, valid information has been written on the tape.
2. Simultaneous Reading, Writing, and Computing. The 766 Data Synchronizers with independent control permit computing to proceed concurrent with the transmission of information between any combination of multiple input and output units and magnetic core storage. In addition, they provide facilities for real-time operations.
3. Large Capacity Magnetic Core Storage. 32,768 "words" of magnetic core storage, equivalent to over 196,000 alphabetic characters or 327,000 decimal digits, provide larger

capacity needed for internal high-speed handling of volumes of data, tables, and lengthy programs. 4,096 and 8,192 word capacities are also available.

4. **Automatic Indexing Facilities.** Three Index Registers permit automatic counting and address modification, resulting in a large reduction in programming effort program length, and storage requirements.
5. **High-Speed Arithmetic.** Higher speeds are attained on multiplication operations, and most arithmetic and logic instructions can be executed at the approximate rate of 42,000 per second. The 709 has the ability to pass over zeros in the multiplier or multiplicand.
6. **Automatic Floating Point Arithmetic.** Fully automatic floating point arithmetic instructions enable automatic recording and retention of the size of numbers during long sequential calculations.
7. **Magnetic Tape Interchangeability and 704 Program Compatibility.** 709 magnetic tapes are interchangeable with 727 tape equipment, and existing 704 programs may be run on the 709 without alteration, except for changes in input-output routines and floating point overflow-underflow.
8. **Larger Vocabulary of Instructions.** The 709 provides a new system of powerful instructions for increased logical ability and greater programming ease and flexibility. The new Convert instructions, unlike any found in present-day stored program computers, have been developed to decrease the execution time and the programming difficulty of "house-keeping" operations by enabling faster and more simplified conversion between any two number systems. In addition, these instructions permit arithmetic calculations to be rapidly performed using a number system other than that which is basic to the 709. Now all problem data may be kept in whatever form is most economical and desirable, rather than in a pre-established format to meet machine requirements. The 709, with convert instructions and logical ability can rapidly and easily convert input information to another form for computing or processing this information in its original form.

Interpret instructions facilitate compiling and interpreting by allowing the substitution of only one instruction for each pseudo instruction, and by eliminating the necessity of having a special entry into an interpretive mode.

Indirect Addressing simplifies the logic of data manipulation and facilitates internal handling of information.

The computer also incorporates new logic instructions, floating point arithmetic instructions and many others. In addition, its logical ability has further been advanced with the development of 36 internal sense indicators, which may be used in a program to alter the sequence of operations depending upon the status of the sense indicators.

#### LINCOLN LABORATORY - M.I.T. - LEXINGTON, MASSACHUSETTS

Construction of the TX-2 computer at the Lincoln Laboratory of M.I.T. is part of the Lincoln program for the study and development of large-scale digital computer systems. The TX-2 incorporates several new developments in high-speed transistor circuits, large capacity magnetic-core memories, and flexibility in machine organization and is designed to work efficiently with many input-output devices of different types. In the course of development of the TX-2, Lincoln has constructed a small self-checking multiplier system which is on life test, and a complete, though skeletal, general-purpose computer known as the TX-0 which is now in operation.

The TX-2 is a general-purpose parallel binary machine with a code of 64 single-address instructions and 84 index registers. The design provides for a random access memory of 260,000 36-bit words. The instruction code includes the usual arithmetic and logic operations executed at a peak rate of 160,000 36-bit additions per second, with several interesting variants. A unique feature of the central computer is its ability to deal with operands in one 36-bit, one 27- and one 9-bit, two 18-bit, or in four 9-bit configurations. These configurations

are specified by each instruction - a feature which permits the 9-bit quarters of the arithmetic element to be connected in various ways to corresponding quarters of the memory. Control is exercised over the activity of the quarters during the execution of the instruction.

The computer design utilizes the "multiple sequence program technique" to permit the concurrent operation of a number of input-output devices. A stored program (instruction) counter is associated with each input-output device. The programs referred to by these counters time-share the hardware of the central computer, giving attention to the associated input-output devices as required. A priority system ranks the devices according to speed and type for efficient operation with a minimum of programming restrictions. The multiple-sequence program technique provides an environment in which buffer storage may be considerably reduced at a small cost in machine speed within the limits set by peak and average data rate considerations.

**MODELS 20 AND 40 DDA - LITTON INDUSTRIES -  
BEVERLY HILLS, CALIF.**

The LITTON 40 Digital Differential Analyzer is now available on regular delivery schedules, and several have already been delivered. This unit has twice the capacity of the LITTON 20 (i.e., 40 integrators) while retaining the same physical size, weight, and power consumption. This unit is identical in construction to the LITTON 20 with the same control panel except for the integrator-identification code wheel which now reads forty values instead of twenty. The LITTON 40 also operates compatibly with the same input-output equipment as the LITTON 20. In fact, owners of LITTON 20's can convert their present units to LITTON 40's with a special conversion kit for the regular price differential.

Litton will have available shortly higher capacity DDA's but no detailed specifications are ready at the present time. In the near future to be available as a standard item is a four-output digital-to analogue converter unit which reads the incremental output of any four digital integrators and converts these to analogue voltage form as helical potentiometer outputs. This device has been operational but not in production quantities.

The 20DDA is being set up for use in a novel application by one of its new owners. In this case, it will be used as a digital simulator of certain jet-engine characteristics in a closed loop containing a general purpose digital computer and a large analogue computer. The 20 receives analogue control voltages and delivers both digital and analogue outputs to be used by the large general-purpose computer.

While continuing deliveries have been made since last June to commercial and military installations all over the country, operational statistics have shown the predicted reliability of the units to be excellent. There have been no major operational failures anywhere. In one case, a unit ran five months, eight hours a day, without any maintenance checks. The first failure in this latter unit proved to be a diode failure. The majority of minor field disorders usually was quickly traced to a diode problem. This area has been a problem in all digital computers and while LITTON has had the best diode available, these are still problems. Just recently, there became commercially available a higher-reliability and longer-life diode which is already being readied for insertion in the new computers.

**NAVAL AIR TEST CENTER - U. S. NAVAL AIR STATION - PATUXENT RIVER, MD.**

A second Model 544 DataReader (Magnetic Tape Storage Unit) has been ordered to increase the storage capabilities and the versatility of the ElectroData Computer system. A Model 360 Floating Point Control Unit has been ordered to reduce programming time, to reduce the computer time required for program "debugging," and to generally increase the operating efficiency of the Computer.

The operating statistics (based on an 8.5 hour shift per day) for the three calendar months ending 31 January 1957 are as follows:

|             | November |       | December |       | January |       |
|-------------|----------|-------|----------|-------|---------|-------|
|             | Hours    | %     | Hours    | %     | Hours   | %     |
| Useful Time | 185.6    | 97.4  | 144.2    | 86.3  | 119.7   | 63.7  |
| Down Time   | 5.0      | 2.6   | 22.9*    | 13.7* | 68.2*   | 36.3* |
| Total Time  | 190.6    | 100.0 | 167.1    | 100.0 | 187.9   | 100.0 |

#### Analysis of Useful Time

|                       | Hours | %    | Hours | %    | Hours | %    |
|-----------------------|-------|------|-------|------|-------|------|
| Code Checking         | 53.1  | 27.9 | 30.6  | 36.3 | 26.6  | 14.2 |
| Production Computing  | 110.0 | 57.7 | 54.2  | 32.5 | 69.7  | 37.1 |
| Demonstrations        | 0.3   | 0.1  | 1.9   | 1.1  | 0     | 0    |
| Idle                  | 0.5   | 0.3  | 2.9   | 1.7  | 0     | 0    |
| Scheduled Maintenance | 21.7  | 11.4 | 24.6  | 14.7 | 23.4  | 12.4 |
| Total                 | 185.6 | 97.4 | 144.2 | 86.3 | 119.7 | 63.7 |

#### NC304 - THE NATIONAL CASH REGISTER COMPANY - DAYTON 9, OHIO

A program to produce a new type of electronic data-processing system for general business use was announced by the National Cash Register Company. Designated as the NCR 304, the new system will provide automatic accounting, auditing, reporting and other business record-keeping functions in one continuous high-speed operation.

The General Electric Company has been awarded a contract to develop and produce many key elements of this system. NCR will construct the system's electro-mechanical parts and will market and service the new system through its 500 sales and service outlets across the United States. The Computer Department of General Electric, located in Phoenix, Arizona, will be responsible for the production-engineering and production of the electronic computing elements of the equipment. The system specifications were designed exclusively for business applications by the NCR Electronics Division in Hawthorne, California, working in conjunction with the Company's Engineering and Product Development Division at Dayton. During the past two years NCR has conducted exhaustive studies of record-keeping requirements in major lines of business. It is from these studies that the basic concepts and specifications of the new system have evolved.

Consisting of a central electronic computer, magnetic-tape memory units, media converters and various high-speed input and output equipment, the 304 is transistorized throughout. The computer employs a magnetic core memory and unique circuit designs to provide unusual flexibility in meeting business needs. A prototype of the NCR 304 system is currently under construction and will be completed this year. The first production model is scheduled for delivery in approximately two years.

Cost of the system will vary with the type of installation, and prices of various units and over-all systems will be announced at a later date. System specifications and other detailed information concerning its electronic innovations will also be forthcoming.

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\*The increase in "down time" during the months of December and January was caused by a failure in the magnetic drum assembly of the "Datatron." Replacement of the magnetic drum was accomplished by representatives of the manufacturer under the unexpired warranty.

#### RAYDAC - NAVAL AIR MISSILE TEST CENTER - POINT MUGU.

A new and larger liquid cooling system was installed to provide adequate cooling capacity for the greater heat load imposed by the addition of the input-output equipment. The old cooling system will remain as a standby in the event of a breakdown of the new system.

A general purpose integration program was prepared which includes the predictor-corrector equations and error analysis as presented by Yowell. The routine employs the Euler iteration scheme for initial approximations and re-starts. The error analysis is tied in with an "h-shifter" which determines the interval of integration at any step as a function of the accuracy required. The computation time is about one-half the time required by the previously used Runge-Uutta integration routine.

#### NEW YORK NAVAL SHIPYARD - BROOKLYN, N. Y.

The New York Naval Shipyard is installing two G-15 Bendix Computers and two magnetic tape units in the COMPASS ISLAND, a converted cargo ship, especially equipped with stabilizer fins, as part of its navigation system installation. The over-all project is the development of a high precision navigation system for surface ships to obtain heretofore unheard of accuracies in navigation position fixes without the use of shore-based electronic navigation aids. This work represents one of the first steps in the advancement of special ship navigation sciences in past 100 years.

The G-15s are being used as part of a system for deriving as exact and fast as possible a method for determining the latitude and longitude required by missile launching. The computers will be connected to a digitizer that decodes electrical impulses into the binary code to eliminate manual type-in, and the magnetic tape units will store the data on approximately 1500 stars. Topside equipment mounted on special stabilized platforms includes a Star Tracker, Horizon Follower, and TV Theodolite. Early in 1957 a dry-run of the computer program using manual typein is scheduled, with the final test to be held in 1958.

#### TRANSAC MODELS - PHILCO - PHILADELPHIA, PENNA.

Philco has announced the following specifications and features for their TRANSAC S-1000 and S-2000:

S-1000 Scientific Computer. Parallel Machine; 36 - digit word length; One's complement binary arithmetic for internal calculations; Two-address instructions with two 12-digit addresses, two 3 - digit address modifiers, and a 6 - digit command; one instruction per word; Magnetic core memory with 12 microsecond cycle time; Memory capacity of 4,096 words; Arithmetic speeds (exclusive of memory),

|                         |     |              |
|-------------------------|-----|--------------|
| Addition & Subtraction: | 5.5 | Microseconds |
| Multiplication:         | "   | "            |
| Division:               | 200 | "            |

All transistor circuits in arithmetic and memory sections; Volume of arithmetic section, memory section, power supplies, control panel and ventilating equipment occupies about 36 cubic feet; About 1.2 kilowatts in power; Cathode Ray memory address reference indicator.

Auxiliary Devices: High speed perforated tape reader and punch at 60 characters per second for either 5 or 7 level tapes. Punched card equipment, magnetic tape and magnetic drum can be added, if desired. Teletype model 28 keyboard and page printer is provided for manual insertion and read-out.

S-2000 Electronic Data Processing Computer. Parallel machine; 48 - digit word length; Two's complement binary arithmetic for internal calculations; Single-address instruction with 16 digits for the address and 8 digits for the command; Two independent instructions to a word;

Magnetic core memory with destructive read cycle of 5 microseconds, and write cycle of 7 microseconds. (The read and write cycles can be used either separately or together in sequence.); Initial memory capacity of 4,096 words;

**Arithmetic Speeds (exclusive of memory access time) Microseconds**

|                         | Average | Minimum | Maximum |
|-------------------------|---------|---------|---------|
| Addition or Subtraction | 1.5     | 0.5     | 6.3     |
| Multiplication          | 60.0    | 45.0    | 300.0   |
| Division                | 80.0    | 50.0    | 300.0   |

All transistor circuits in the arithmetic and memory sections; Volume of arithmetic section, memory section, power supplies, control panel, and ventilating equipment occupies about 48 cubic feet; about 1.5 kilowatts in power.

**Auxiliary Devices:** Punched card reader and punch at 1200 words per minute for binary information, and 300 words per minute for decimal information. High speed perforated tape reader, either 5 or 7 level tape can be used at up to 200 characters per second. High speed tape punch up to 80 characters per second. Magnetic tape drives of up to 256 units. 75 inches per second tape speed. The magnetic tape units have an information rate of 750 words per second. Error correction provides for single error correction and two - error indication. Magnetic drum of 16,384 words expandable to 24,576 words by adding recording heads and more by adding drums. Parallel mode of reading and writing is used. Toggle switch register provides for human intervention and decision making during control cycles when the machine is used for real-time work. Card to drum, and drum to card, perforated tape to drum, and drum to perforated tape operations are provided to allow for simultaneous operation of input/output devices and internal computations. Electric typewriter and page printer is available for manual insertion of information and print-out. Other input/output devices can be added. For example, high speed printer, random number generator, etc. Magnetic drum access time - The magnetic drum revolves at 3600 rpm has 400 channels and a little over 4000 bits. For one revolution you have 17 milliseconds waiting time.

**WESTERN RESERVE UNIVERSITY - CLEVELAND, OHIO**

The Western Reserve University Searching Selector. At the Center for Documentation and Communication Research, School of Library Science, the starting point for designing this equipment was the realization that documentation systems are called upon to meet a wide variety of information requirements. These range from narrowly defined specific inquiries to comprehensive correlations. More detailed analysis revealed that any given requirement almost without exception involves a combination of several concepts. The Western Reserve Searching Selector permits an exceptionally wide range of concepts to be used in defining and conducting searching operations for the purpose of identifying documents of interest. Identification is accomplished by matching the characteristics of documents with the characteristics of information requests. In conducting a search its scope may be defined not only in terms of specific substances, devices, attributes, processes, conditions, organisms, persons, locations, etc., but also in terms of generic concepts and their relationships to specific terms. Furthermore, observational relationships, for example the roles in a given experiment or situation of various substances, devices, etc., taken either specifically or generically, may also be designated as points of reference in defining searches. The conditioning - or programming - of the selector preparatory to initiating a search is accomplished by wiring a plug board.

The Selector has been designed so that it can detect combinations of symbols and also combinations of combinations at a multiplicity of levels. At each level, combinations may be defined in terms of logical product, logical sum, logical difference or derived complex logical relationships. The different combinational levels may be thought of as analogous to the combining of letters to construct syllables, syllables to construct words, words to construct phrases, phrases to construct sentences, sentences to construct paragraphs, etc. The machine is able automatically to detect the start and end of each organized symbolic unit analogous to word, phrase, sentence or paragraph. This use of analogy, though illuminating, must not be regarded as definitive.

Prior to conducting a search, an information requirement is analyzed in terms of appropriate specific and generic terms, role indicators and logically defined relationships between them. The information requirement is thus analyzed on the same basis as is used to record the information contents of documents in the form of encoded abstracts. The searching step as performed by the Searching Selector consists of a series of logically defined matching operations involving the common set of terms used for analyzing the information requirement and the information contents of documents. The Searching Selector has been designed so that five searches may be conducted simultaneously. Such searches may be interrelated as to scope or completely independent.

## COMPUTING CENTERS

### RADIATION LAB - UNIVERSITY OF CALIFORNIA - LIVERMORE, CALIF

UNIVAC. On November 22, 1956, Univac #5 had its birthday, having been accepted by UCRL in Philadelphia just after predicting the elections in 1952. It has been through almost continuous operation (168 hours per week) since its installation at Livermore in April of 1953.

Cumulative Operating Statistics, April 20, 1953 through January 1957:

|   | Total Hours | Percent |
|---|-------------|---------|
| Bug Shooting & Preproduction                  | 6376.9      | 19.6%   |
| Production                                    | 18672.6     | 57.4%   |
| Lost Time                                     | 1311.5      | 4.0%    |
| Scheduled Maintenance                         | 3078.0      | 9.5%    |
| Non-Scheduled Maintenance                     | 2758.0      | 8.5%    |
| Non-productive (Training, Tape Testing, etc.) | 325.0       | 1.0%    |
|   | 32522.0     | 100.0%  |

LARC. The Sperry-Rand Corporation is maintaining its schedule on the development of the Larc system. UCRL is actively engaged in preliminary aspects of coding both the input-output processor and the main computing unit. Full scale programming and coding is under way and will continue to occupy a major laboratory effort so that there will be little delay in getting the Larc up to full operation. It is anticipated that as many as 25 new experienced programmers will be added to the Computation Division staff to make this goal realizable.

IBM-704. The second IBM-704 was put into operation on July 16, 1956. It has 8192 words of magnetic core memory, 4 logical drums (8192 words) and 7 tape units, being in these respects identical with the first IBM-704 (put into operation February, 1956). Each machine is now operating 168 hours per week.

Cumulative Operating Statistics for the Two IBM 704's (from acceptance through January 1957):

|                              | Total Hours | Percentage |
|------------------------------|-------------|------------|
| Bug shooting & preproduction | 2083.44     | 17.7%      |
| Production                   | 7102.23     | 60.2%      |
| Lost Time                    | 271.76      | 2.3%       |
| Scheduled Maintenance        | 1417.56     | 12.0%      |
| Non-scheduled Maintenance    | 454.09      | 3.9%       |
| Unused Holiday Shutdowntime  | 461.73      | 3.9%       |
|                              | 11,790.81   | 100.0%     |

Off-line output facilities have been made available for the IBM-704's by the UCRL Univac engineers who have adapted the Univac Hi-speed Printer to accept 704 tapes through a Potter Drive Unit.

A Cathode ray tube (IBM-740) has been added to one system. At present studies are being made to determine how it may be used most effectively.

**AUTOMATIC PROGRAMMING.** As a follow up on the Kompiler, K-2 developed at Livermore for the IBM-701, a new compiler K-3 is being completed for the IBM-704. A preliminary manual is now available. Both of these compilers were started in an effort to prepare for the major task of building a Larc compiler. It, also is now getting under way, so that it can be ready when the Larc is delivered.

#### SWAC - UNIVERSITY OF CALIFORNIA - LOS ANGELES, CALIF.

**Operation and Engineering.** The SWAC has been operated on a two shift basis during the past year, at about the same efficiency level as previously. Maintenance of the computer continues to be done, as it has since June 1955, by undergraduates hired on a part-time basis, and supervised by one full time engineer and a graduate student. All modernization and improvement of the computer, including the circuitry of the new drum, have come from this small staff. Despite these limitations, approximately 75% of the "on" time of the computer is spent in useful computing and code checking operations. The remaining 25% is devoted to maintenance and to engineering development and modernization.

The new drum memory of 8,192 words has been in continuous operation since June 1956, with a Ferranti (phase sensitive) NRZ recording and readback system. This has proved extremely reliable. It is estimated that less than 0.1% of the malfunctions of the computer are caused by the drum and its attendant circuitry.

A developmental program has been undertaken under the direction of Dr. G. Estrin which will lead to the replacement of the cathode ray tube electrostatic memory with a magnetic type of the same capacity. It is expected that the RCA ferrite plates will be the basis of the system. Experiments are under way to determine the feasibility of transistors as driving units at the speeds demanded by the computer.

**Problems Solved.** Problems done on the computer by various University departments this year include: 1. Crystallographic studies by the Chemistry Department; 2. Traffic flow simulation, by the Institute of Traffic Engineering; 3. Determination of correlation coefficients in large systems in psychological and educational studies, by the respective departments; 4. Weather forecasting with a 240 station model, by the Meteorology Department; 5. Studies in the analysis of three-move end games of chess; 6. Theory of Fermat numbers; 7. Studies in the inversion of matrices. (5, 6, and 7, were done by the Department of Mathematics).

#### PRINCETON COMPUTATION CENTER - ELECTRONIC ASSOCIATES, INC. - PRINCETON, N. J.

In March 1957 the facilities of the Princeton Computation Center of Electronic Associates, Inc. were expanded to include digital computing equipment in addition to the five most modern Electronic Associates PACE analog computers, which were installed in January of 1957 replacing the analog computers which had been in use since the center opened in 1954. The digital equipment consists of a Datatron computer with high speed paper tape input and output, Model 500 card converter, two magnetic tape units as well as the floating point control unit. In addition, the center also has available an Electronic Associates Model 3033-A2 Dataplotter. This unit can plot data from punched cards or from Datatron paper tape output, and is capable of plotting six different curves as a function of one variable.

The analog computers, the digital computer and the plotting equipment are available on an hourly basis, together, with digital programming and coding as well as analog application engineering services. Inquiries regarding the facilities of the Princeton Computation Center

should be directed to: Princeton Computation Center, Electronic Associates, Inc., P. O. Box 582, Princeton, New Jersey.

**COMPUTING CENTER - FRANKLIN INSTITUTE LABORATORIES -  
PHILADELPHIA, PENNA.**

On January 1, 1957, the Univac Computing Center of the Franklin Institute Laboratories in Philadelphia was officially placed in operation. The nucleus of the Center is a Univac I System which is supplemented by a programming staff well trained in Univac and automatic coding techniques. The type of work which the Center will handle can be divided into two main categories: (1) Problems in which machine time only is required. They will be processed by a full-time Remington Rand representative. (2) Problems in which research and/or development may be involved. These will be handled by the programming staff of the Laboratories on a contract basis.

Analog Computing Facilities have been augmented by the acquisition of an Electronic Associates PACE Computer to provide a total of 84 operational amplifiers, 6 servo multipliers, 2 resolvers, 2 dual channel electronic multipliers, an electronic function generator, and a photo-former.

The Alternating Current Network Calculator was scheduled for 1952 hours in 1956. Of this, 1950 3/4 hours were useful machine time, and 1 1/4 hours were lost in unscheduled maintenance.

Accompanying the Univac system, which is situated in the Franklin Institute Museum Building, is a Remington Rand Computation Exhibit in which a group of displays and drawings depict the history of the art of data processing.

**LOGISTICS RESEARCH PROJECT - GEORGE WASHINGTON UNIV -  
WASHINGTON, D. C.**

**NEW DEVICES.** A contract has been made with Advanced Electronics Manufacturing Corporation, Los Angeles 25, California for the construction of card input and output equipment for use with the G.W. Logistics Computer. The input assembly will be built around an 077 IBM Collator while the output will be handled using a 523 Gang Summary Punch.

New plugboards have been purchased from Aircraft Marine Products Corporation. They contain 48 x 68 holes, and when the new mounting is installed a tripling of the number of program steps now admissible will be possible. Most other functions, electronic selector switches, counter jumps, jumps, etc. will be doubled.

**PROGRAMS.** Advanced Electronics Mfg. Corp. has contracted to make a study of methods for drum addressing from words of varying length from the 7 digit FIIN (Federal Item Identification Number) to a possible 12 digit number. The basic equipment would be a "dictionary" drum. The address or name of a cell containing a given FIIN number would be obtained by searching this drum and the resulting address used to locate storage on our present magnetic drum.

Some of the more recent programs which we have used are as:

- (a) Let x stand for a forty-four digit word and a, b, c, d four of these digits by position. A program has been designed to count in a string of x the number of words containing each fixed a, b, c, d from 0000 to 9999. As many as fifty selections of a, b, c, d are possible via switch settings in the one program. Output is in the form of a matrix edited for zero rows and columns and in which a, b stands for a row and c, d for a column.
- (b) A scheduling problem in which computations of the form

$X_0 E_0$

$X_1 E_0 + X_0 E_1$

$X_2 E_0 + X_1 E_1 + X_0 E_2$

-----

$X_k E_0 + \dots + X_0 E_k$

are performed in succession, the  $k$  answers being printed out automatically between computations.

#### WHIRLWIND I - M.I.T. - CAMBRIDGE, MASS.

Applications. During the last 3 months of 1957, the Scientific and Engineering Computation Group, in conjunction with various departments at MIT, processed 68 problems for solution on Whirlwind I. The problems are described in the Project Whirlwind Summary Report submitted to the Office of Naval Research and cover some 18 different fields of application. The results of 20 of the problems have been or will be included in academic theses. In these 20 problems, there are represented 17 doctoral theses, 5 master's and 1 bachelor's. Twenty-two of the problems have originated from research projects sponsored at MIT by the Office of Naval Research.

Systems Reliability. The following is the WWI Computer Reliability Record for the last quarter of 1957:

|  |        |
|--|--------|
| Total Computer Operating Time in Hours                 | 1836.5 |
| Total Time Lost in Hours                               | 35.8   |
| Percentage Operating Time Usable                       | 98.1   |
| Mean Free Time Between Failure Incidents (in hours)    | 23.6   |
| Total Number of Failure Incidents                      | 84     |
| Failure Incidents per 24 Hour Day                      | 1.1    |
| Average Lost Time per Incident in Minutes              | 25.2   |
| Average Preventive Maintenance Time per Day (in hours) | 2.3    |

Reorganization. The previously discussed plans for the installation of the Type 704 Computer, in the new Karl T. Compton Center, are proceeding as scheduled. It is expected that the computer will be in operation by April 1957, at which time many of the staff members will be spending most of their time working on the 704 computer.

Sometime during the summer Whirlwind will be turned over to Lincoln Laboratory for full-time use. The exact date of this has not been determined, since it depends on work being done on Whirlwind.

#### APPLIED MATHEMATICS DIVISION - NATIONAL BUREAU OF STANDARDS - WASHINGTON, D. C.

The computing facilities of the National Bureau of Standards, now consisting of the SEAC, will be greatly increased by the installation of an IBM 704, delivery of which is scheduled for May 1957. It is expected that a major part of the first shift of operations will be required for problems of the Bureau and of the Diamond Ordnance Fuze Laboratories. The remaining time will be available for problems of other Government agencies.

#### NAVAL ORDNANCE COMPUTATION CENTER - NAVAL PROVING GROUND - DAHLGREN, VIRGINIA

ARC. The dismantling of the Aiken Relay Calculator (ARC) in January 1957 marks the end of a pioneer among large-scale digital computers, preceded only by the Harvard Mark I,

the ENIAC, and the BTI relay calculator. To many persons now prominent in the computer field, the event will bring to mind early experiences obtained through association with the birth of this calculator, originally known as the Harvard Mark II.

The project to build the ARC originated from the needs of the Naval Proving Ground, a Bureau of Ordnance activity, for the preparation of fire control tables for the fleet. Under the direction of Professor Howard H. Aiken the Harvard Computation Laboratory spent about a year in research and design, and in early 1948 began construction of the calculator. Most of the components of which the ARC was constructed were designed especially for the ARC, including the 13,000 relays which enabled it to compute faster than previous relay calculators.

During most of its life the ARC operated around the clock, five days per week. It produced a large volume of results from many types of problems and achieved an enviable record of reliability and efficiency. In early 1956 most of the ARC staff was transferred to the newly-arrived NORC, after which the ARC operated on a diminishing schedule until retirement in September 1956.

**NORC.** The Naval Ordnance Research Calculator (NORC) continues operation on three shifts, five days per week. During the year 1956 it was available 86 per cent of the 4803 hours of scheduled operating time.

**ADEC.** The Aiken Dahlgren Electronic Calculator (ADEC) is being maintained on a standby basis for use as needed.

**Computing Services.** Plans are now being made for the allocation of computing services on the NORC during the fiscal year beginning 1 July 1957. Interested organizations and activities are reminded that NORC computing time, in large or small amounts, is available at a cost of less than \$200 per hour. Programming, mathematical research and analysis, and consulting services are also available at cost. Further information may be obtained from: Director, Computation and Exterior Ballistics Laboratory, U. S. Naval Proving Ground, Dahlgren, Virginia.

#### DIGITAL COMPUTING CENTER - THE RAMO WOOLDRIDGE CORPORATION LOS ANGELES, CALIF.

The Digital Computing Center has been in operation at the Ramo-Woolridge Corporation since summer 1954. Organized as a department of the Computer Systems Division, the staff now numbers over 100 and consists of mathematicians, engineers, and physicists engaged in mathematical analysis and computer applications. The equipment operated by the Center consists of desk calculators, tabulating equipment, a Burroughs E-102 computer, and a Univac Scientific Model 1103 computer.

The 1103 has been in operation since August 1, 1955. A summary of the scheduled 5729 hours for the 18 months up to January 31, 1957 is as follows:

|                  | Hours | Percent of scheduled |
|------------------|-------|----------------------|
| Program Assembly | 446   | 7.8                  |
| Code Check       | 1699  | 29.6                 |
| Demonstration    | 30    | 0.5                  |
| Production       | 3119  | 54.5                 |
| Total good time  | 5294  | 92.4                 |

Mean error-free time during this period was 9.8 hours. During recent months the number of code check passes averaged about 60 per day with an average computer time of about 8 minutes per pass. Currently the computer is used on three shifts.

Future plans call for replacing the Model 1103 with the newer Model 1103A in April 1957. The Model 1103A includes magnetic tape input-output, magnetic core memory, and built-in

floating point. Also, expansion plans for the fall of 1957 include acquisition of an IBM 704 computer.

The principal application of the computer is in connection with the Corporation's role in systems engineering and technical direction of the USAF's ICBM and IRBM projects. Besides guided missile research and development, applications include: real-time application of digital computers, digital computer design, nuclear reactor analysis, and business data processing. Programming activities include the preparation of the official 1103A compiler for the USE (Univac Scientific Exchange) Organization and the development of a comprehensive computation system for automatic machine running of problems. Extensive numeric analysis research is underway in areas of ordinary and partial differential equations and eigenvalues of non-symmetric matrices.

## COMPUTERS, OVERSEAS

### BESK - SWEDISH BOARD FOR COMPUTING MACHINERY - STOCKHOLM, SWEDEN

In September 1956 our previous Williams memory was replaced by a ferrite core memory for 1024 forty bit words. Because of this we could reduce our daily preventive maintenance from 5 hours to 2.5 hours. BESK is running twenty-four hours a day and no intermediate stops are made for holidays. Up to now no defect in the core memory has been noted. The percentage of lost time due to machine defects was 6.3% during the first three quarters of 1956, and during the last quarter only 3.3%.

Our staff consists at present of 33 members: 13 mathematicians, 11 engineers for running and maintenance, 3 punching operators, and 6 for general administration.

Our technical research department has been completely reorganized. Since 1st April, 1956, Mr. Gunnar Havermark has been Director of the Working Group of the Board, and since 1st May, Mr. Germund Dahlquist has been head of the mathematical staff.

Most of the coding is done by the customers. A system of coding with symbolic addresses has been designed. Three programming courses were arranged in 1956 with a total of 160 attending. A coding handbook has been written (in Swedish).

Some new problems on BESK are: elastokinematical and servotechnical problems in turbine design, oceanographical forecasts, X-ray crystallography, statistical analysis of hydrological data of the power producing rivers of Sweden, regulation of lakes for optimal storage capacity, highway earthmoving problems, Leontieff matrices, artificial telephone traffic trials.

The construction of BESK-descendants is being carried out by the Swedish firms: AB Atvidabergs Industrier, Stockholm and Svenska Aeroplans AB, Linkoping.

### BIRKBECK COLLEGE COMPUTATIONAL LABORATORY - UNIVERSITY OF LONDON, ENGLAND

The machine U.C.C. of general A.P.E.X.C. type which the laboratory has constructed for University College, London, is now operating. Amongst problems solved on U.C.C. are coupled systems of differential equations, tabulation of functions involved in nuclear structure, and matrix manipulations.

A.P.E.X.C. has been nearly fully occupied in the investigations of machine translation of language. In this field a programme has been completed for the transcription of standard English into Braille, the output taking the form of a punched tape which is readable by blind operatives. The translation of French into English is now in an operating state and although

work remains to be done on micro-glossaries this does not, directly, involve the machine or the programmers whose work is complete.

During 1956 A.P.E.X.C. has had one run of 3 months without error or servicing, and another of 6 weeks.

The Wharf Engineering Laboratories machine, M.A.C. has been used only for programme testing but during 1956 it has not required servicing and is at the time of writing, still reliably operational.

#### ELLIOTT BROTHERS LTD. - LONDON, ENGLAND

The operating statistics for Elliott's own 402 digital computer for 1956 (representing the first complete calendar year) are listed below. This computer is one of the Computing Service machines located at Borehamwood, Herts.

|   | <u>Hours</u> |
|---|--------------|
| Total available computer time (operating on a<br>40-hour week less 5 Bank Holidays) | 2040.0       |
| Actual active time for all purposes   | 1947.9       |
| Idle time, time lost due to machine faults and<br>input preparation errors          | 304.6        |
| Engineering and maintenance time  | 153.9        |
| Actual production time  | 1489.4       |

#### INSTITUTE OF THEORETICAL PHYSICS - UNIVERSITY OF LUND, SWEDEN

SMIL (Siffer-Maskinen i Lund, the digital machine in Lund) is a medium speed - low cost electronic computer built at the Department of Theoretical Physics, Lund University. The arithmetic unit is a copy of the corresponding part of BESK in Stockholm. The memory is a parallel magnetic drum rotating about 6000 rpm, with a storage capacity of 2048 forty digit binary numbers. SMIL has further a dielectric tape-reader and a conventional typewriter.

Numbers are represented with a sign digit and 39 binals. The machine uses one-address-code and has 15 different operations represented by one hexadecimal digit; the operations are specified more precisely by a second digit. Optimum coding is feasible and will in general reduce the operation time from 7.5 to 2-3 milliseconds.

SMIL has about 2000 tubes and about 200 germanium diodes but no transistors. The total heat dissipated by the machine is about 12 kw. Whether the drum will be replaced with a ferrite core memory still remains an open question. The machine has been in operation since June 1956.

## COMPONENTS

#### IBM - NEW YORK, N. Y.

IBM has announced the development of a new model electric typewriter for use as an input and output data processing device. The new machine automatically types at a rate of 120 words a minute or approximately twice as fast as the average typist. It can be used in conjunction with computers as well as with measuring and recording instruments, scales, and meters in such applications as engine testing, liquid flow through pipelines, production control, wind tunnel research and others, to provide a visual record. The input-output typewriter is operated by a series of electro-magnets and solenoids mounted beneath the keyboard. The magnets

and solenoids automatically actuate keyboard functions of the typewriter, including carriage return, spacing, tabulation, ribbon color control and others. When used as an input device, electrical impulses are transmitted from the typewriter by depressing a key. It is approximately the same size as a standard IBM electric typewriter and may be used for general office procedure. The unit is available with carriage lengths up to 30 inches and is priced from \$740.

#### NORDEN-KETAY CORPORATION - HAWTHORNE, CALIFORNIA

The **PACKAGED DIGITAL COMPARATOR** developed by the Norden-Ketay Corporation provides a component which allows the creation of a digital servo system using conventional servo components and techniques. Briefly, the digital comparator will accept two parallel binary numbers, obtain the digital difference between the two numbers and put out an error signal that indicates the magnitude and sign of the difference. Since the error signal is of a type conventionally used in servo systems, the digital comparator may be associated with a conventional servo amplifier and motor. It is important to note that results of the digital comparator are completely unambiguous since it does not rely upon counting technique and since the error signal, which is analog, is derived from a digital error signal rather than from the difference of two analog signals.

The digital comparator is completely transistorized occupying a volume of approximately 420 cubic inches without power supply. The unit has been tested successfully between the temperature limits of -50° centigrade and +50° centigrade.

The digital comparator offers the following advantages over analog servo systems:

- (a) It can be readily programmed for information stored on tape or cards.
- (b) It controls to one bit accuracy over the complete range, thus for 19 bit information it will control to better than one part of 524,288.
- (c) There is no tendency to drift and once its zero point is established, it requires no further adjustment.

#### PHILCO - PHILADELPHIA, PENNSYLVANIA

A **TRANSAC arithmetic control unit** is now under study by the government for inclusion in a large computing system. Developed at Philco's Government & Industrial Division, this computing unit occupies only one-third cubic foot and weighs less than 12 pounds. It operates on 3 volts potential and employs Philco's direct-coupled circuitry thereby eliminating many components usually found in electronic computers. The unit contains nearly 1,000 tiny transistors, 300 resistors and 12 capacitors permanently dip-soldered into compact, plug-in, printed-circuit cards. Each card provides all the necessary functions for one binary digit including add, subtract, multiply, divide, square root, shift right, shift left, sign magnitude and absolute magnitude. Ten "math" cards and seven "control" cards are plugged into the 10" long unit to provide all arithmetic processing facilities between conventional input and output devices. Input-output connections are made by plugs. The unit adds two numbers in 1.5 microseconds, and multiplies in 15 microseconds. A row of indicator lights provides visual display of results. TRANSAC math-control units with larger digital capacities can be built in "building block" fashion by simply increasing the number of plug-in "cards."

#### RCA LABORATORIES - PRINCETON, NEW JERSEY

**FERRITE MEMORY PLATE.** A simple method of fabricating a plate containing a large array of memory cells\* is a development of RCA Laboratories that promises to greatly increase the storage capacity of even the largest present-day digital memory systems.

\*See Digital Computer Newsletter - Jan 1957

The 7/8" by 7/8" plate, which is made of nonconducting ferrite metal, is molded with 256 holes, each .025" in diameter. The holes are arranged in 16 rows of 16 holes each. The plate is then coated with a conductive pattern to form a printed winding linking all holes in series. Large stacks of these plates can be readily wired together to form an easily-assembled large-scale memory. This is a major improvement over current laborious methods of assembling memory cells individually, and opens possibilities of memories with capacities of millions of bits.

The plates will be available commercially through the RCA Electronic Components Division, Camden, N. J.

#### REMINGTON RAND DIVISION OF SPERRY RAND - NEW YORK, NEW YORK

An electronic punched tape typewriter that prepares a by-product punched paper tape as original documents are typed has been developed by Remington Rand Division of Sperry Rand Corporation for use in conjunction with electronic data processing systems.

The new typewriter, latest addition to the Remington Rand line of "common-language" equipment designed to provide fully automatic recording and communication of business data, automatically produces punched tapes as electronically activated typewriter keys are depressed, on a standard, single bank typewriter keyboard. The system also reads punched tape and automatically types its contents at a speed of approximately 120 words per minute. The data on the tape, in turn, may be sent over wire service to a central data processing point for fully automatic reproduction of the sales order. In addition, the data received may be fed directly into the Remington Rand Univac File-Computer System, or into the Univac Computer after conversion to magnetic tape.

The system has separate reading and punching units, and is available with either or both. The model being demonstrated punches a 5-hole code which is the one principally used by wire services networks. The equipment and system, however, can be designed for 6, 7, and 8-hole codes.

## MISCELLANEOUS

#### G15 - BENDIX COMPUTER DIVISION - LOS ANGELES, CALIF.

As of February 1, 19 orders have been received for G-15A's and 30 orders for G-15D's. Several of the G-15D installations are using the DA-1 accessory for combined digital differential analyzer/general purpose computer operation. A major oil company installation reports up-time figures for the past nine months of 90% with the computer in operation an average of 100 hours per week. The Illinois Division of Highways installation reports for the first five months of operation a total of less than one day of down time.

The first G-15 User's Conference was held March 19 and 20 at the Hotel Statler in Washington, D. C. The conference was arranged at the request of customers to serve as a medium for information exchange. Tak Yamashita, manager of the Bendix Applications Section, formulated the initial arrangements and a steering committee was selected to determine the future planning of the group. Talks were given by Joseph P. Grandine, 3nd, Ph.D. and Donald Peaseman, Ph.D., on programming techniques and the computer philosophy on which their respective installations are based; and by Michael Blair and James Langley on installation systems from the maintenance man's viewpoint. Some of the customers exhibited supplementary devices in use at their own installations.

## ELECTRODATA - PASADENA, CALIFORNIA

Delivery to Norton Air Force Base of the first CARDATRON System\* has been announced by the ElectroData Division of Burroughs Corporation. Norton will use the new system, in conjunction with a DATATRON electronic computer, for control of its \$3-billion aircraft parts inventory at San Bernardino. The base supplies air force installations throughout the Southwest and in many parts of the world.

Under development for two years, CARDATRON is a versatile input-output system which enables conventional electro-mechanical punch-card machines to work effectively with electronic computers.

CARDATRON eliminates the usual "drag" of punched card equipment on these high-speed computers by permitting the use of several card machines simultaneously. This gives DATA-TRON one of the most flexible card input-output facility of any data processing system on the market.

Orders have been booked for 32 CARDATRONS. An average system, selling for approximately \$130,000, consists of a single control unit with two input and two output units. As many as seven input or output units, in any combination, may be linked to the various card-handling devices through a single control.

Magnetic drums in the CARDATRON eliminate the need for most of the complicated plug-board wiring required by card machines. Information is stored temporarily on the drums and transferred to or from DATATRON in a few thousandths of a second.

Automatic card editing, scaling and code translation free the computer from the slow-speed limitation of card machines, and allow simultaneous operation of several programs in the computer. At Norton, for example, synchronous programs check the accuracy of the air base's \$3-billion inventory stored on 300,000 punched cards, and update these records daily. Estimated savings in processing time, according to Norton officials, will be fifty percent.

**PRODUCTION AND MARKETING.** Electrodata is presently producing 5 DATATRONS a month, and plans to increase this to eight in 1957. In addition to the manufacturing and marketing of DATATRON, Electrodata is also responsible for the distribution of the Burroughs Corporation Series E desk-size computers and Series G high-speed printing, tabulating and punch-card equipment since its corporate merger with the Burroughs Corporation in July of 1956.

## READIX COMPUTERS - J. B. REA CO. - SANTA MONICA, CALIF.

A readix Decimal Electronic Digital Computer, manufactured by J. B. Rea of Santa Monica, California, was delivered to the Air Force Armament Center of the Air Research and Development Command. The installation was made at the Data Reduction and Research Branch, Precision Bombing Range, of the Ballistic Test Facility in Pasadena, California. To date, four Readix Computers have been completed. One has been delivered to the E. I. duPont Company of Wilmington, Delaware, two have been delivered to the Air Force, and the fourth is being used by the Rea Company in place of the IBM computer which it previously leased.

By way of background, the Precision Bombing Range, operated by the Ballistics Test Facility under the Command of Major James W. Heyroth, does experimental and development testing of aerial bombs and munitions. Optical and electronic instruments designed and manufactured for the range, obtain accurate data of bomb trajectory. Space measurements are accurate to .01 of one per cent, and time measurements to .001 seconds. Data gathered from the test bombing runs are sent to the Ballistic Test Facility, Data Reduction and Research Branch.

\*See Digital Computer Newsletter - October, 1956

The Facility believes that with the Readix Computer, they will now be able to process data much faster, with a notably higher degree of accuracy at substantially lower cost to the Air Force. They further reported that the availability of the computer will facilitate a 300% increase in the speed of reducing the precision bombing reports which are so vitally needed.

The Ballistic Test Facility operates and maintains a bombing range at Edwards Air Force Base. The most modern photographic, electronic and surveying instruments are employed to make precise measurements and recordations during test drops. This raw observation data is analyzed and measured by trained mathematicians and technicians, using highly accurate semi-automatic film reading devices. The readings thus made are automatically recorded on paper tape by utilization of specially designed punches.

The Readix Computer will serve as the nucleus of the data reduction and research program. The paper tape on which the film measurements are punched, will be fed into the computer. The computer will then automatically compute time - position - velocity - acceleration data, which will describe the performance of the unit being tested. Whereas by hand computing, it formerly took as much as a week to reduce a round of data, the advance design of the Readix will accomplish all the requisite computations in approximately one hour. After the computations have been thus completed, they will be tabulated, reviewed and transmitted to receiving agencies at Eglin Field, Florida, and Kirtland Air Force Base, Albuquerque, New Mexico and other Air Force Agencies. Air Force Agencies will then utilize the data for formulation of bombing tables, and preparation of test reports.

#### SOUTHERN RAILWAY SYSTEM - ATLANTA, GA.

Southern Railway System has announced it has received and is now operating the first IBM 705, MODEL II. Their Model II contains 40,000 words of core storage memory, which is twice amount in other 705's.

Southern's use of the computer will include the preparation of sales information on traffic statistics, the distribution of revenue among railroads participating in the movement, and the preparation of reports and statistics for the Interstate Commerce Commission. Other paper work to be given to the Computer includes payroll processing. The machine will compute earnings, deductions, taxes and net pay, prepare paychecks and earnings statements, distribute labor costs and keep year-to-date records required for reports to federal, state and city authorities. In both fields, the 705 will develop reports and studies of value to management. Plans are under way to extend its use not only to other phases of accounting and record-keeping but to costs and traffic comparisons, management reports and special studies, stockholders' and pension records, earnings forecasts, and possibly the distribution of freight cars.

#### CONTRIBUTIONS FOR DIGITAL COMPUTER NEWSLETTER

The Office of Naval Research welcomes contributions to the NEWSLETTER. It is hoped to continuously improve the contents of this newsletter and to make it an even better medium of exchange of information, between government laboratories, academic institutions, and industry. It is hoped that the readers will participate to an even greater extent than in the past in transmitting suggestions and technical material to this Office for inclusion in future issues. Because of limited time and personnel, it is often impossible for the editor to acknowledge individually all material which has been sent to this Office for publication.

The NEWSLETTER is published four times a year on the first of January, April, July, and October and material should be in the hands of the editor at least one month before the publication date in order to be included in that issue.

The NEWSLETTER is circulated to all interested military and government agencies, and the contractors of the Federal Government. In addition, it is being reprinted in the Journal of the Association for Computing Machinery.

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